ARCO - Eo NRO
Central Comp PH,
G-HX-I
Gen Corresp

ARCO Alaska, Inc.
Post Office Box 100360
Anchorage, Alaska 99510-0360
Telephone 907 276 1215

RECEIVED
NOV 29 1989
AOO-JUNEAU

RECEIVED
NOV 24 1989
Department of
Environmental Conservation

November 22, 1989

Mr. Leonard Verrelli, Chief
Air Quality Management
Division of Environmental Quality
Alaska Department of Environmental Conservation
P. O. Box O
Juneau, Alaska 99811-1800

Dec - 1989

Dear Mr. Verrelli:

RE: Gas Handling Expansion-1 (GHX-1) Air Quality Permit Modification
Response to Incompleteness of Application

This letter and enclosures are our response to your July 5, 1989 request for additional information. The following is our response to your requests, in the order that they appeared in your correspondence:

Item 1. a. Manufacturer's guaranteed emission rates in lb/hr and exhaust volume concentrations in ppm for each regulated contaminant.

Response: The vendor information, based on North Slope fuel gas, is in the form of expected or guaranteed, not "nominal" emissions. Although you have asked for base and peak load conditions, the proposed new and modified turbines will be in continuous, steady-state driver applications and thus will not have base/peak loads. The information is provided in Exhibit I, attached.

Item 1. b. Provide the heat rate in kilojoules per watt-hour of Btu per horsepower-hour for each class and size of turbine.

Response: The information is provided in Exhibit I, attached.

Item 2.a. Provide the data, associated calculations, and the emissions in tons per year of each criteria air contaminants from each of the existing sources for the previous two calendar years: i) actual operating rate, percent rated capacity, and hours per year; ii) fuel burning rates, including actual annual average and maximum hourly fuel consumption in scf/hr; iii) heat content of the fuel in MMBtu/scf, and percent bound Nitrogen; iv) estimated or actual emission rates for each regulated air contaminant, in lb/hr or gm/sec; and v) estimated or actual emission concentration for each regulated air contaminant in ppm.

Response: The information requested is provided in Exhibit II, in tabular form. The heat content is also provided as requested in item iii, and there is essentially no bound nitrogen in the fuel gas.

In order to respond to these questions, it was necessary to compile, sort and analyze a large amount of data and information. The work took two directions.

The first was to describe the permit history for all of the sources at the Central Compressor Plant (CCP). This was done to establish what sources were permitted, at what point they were permitted, and any limits associated with that permit action or source. As you know, this was not a simple task, since the permit history of a particular source in many cases had a complex path leading to actual installation. We find that there is an authorization path for each of the sources installed at CCP. A summary of this history has been prepared, and is submitted as Exhibit III in the attachments.

The second effort was to examine all the data available to us on the emission sources to provide what you requested in Item 2.a. This was as arduous as digging through our permit files, but it was important, and interesting as well.

During our study of the information, it became clear that the emission factor for any specific turbine machine was not a constant through its range of operational conditions. The data obtained from the manufacturer that displayed emissions, fuel consumption and ambient temperature confirmed this. Since CO and NOx emissions are the pollutants emitted in the largest amounts, these two air contaminants were studied in greater detail. A mathematical function was empirically derived for NOx and CO, to better describe the emission factors throughout the range of operational conditions for each machine type. The mathematical function was derived to match manufacturer emissions and performance data with varying ambient temperature and fuel consumed. In addition, any available source test data were included as part of the curve of all data points that describe a particular machine. This function was then applied to the fuel use and ambient temperature field data, resulting in a narrow range of emission factors. An average of these factors was used in estimating emissions. These derived factors from actual performance of the equipment are compared to AP-42 data and source test data on Exhibits IV and V.

There is generally very good correlation among the data for any given machine, regardless of the basis for the emission factor, whether it is AP-42, source test, or derived. Although there are differences in the absolute values of the different emission factors, particularly for the empirically derived values, this is a demonstration of the nature of an emission source whose combustion conditions undergo large changes. The exhibits are used to further rationalize the empirically derived emission factor, that was used in all other computations. This study convinced us that the derived emission factors are best representations of the wide range of ambient conditions that the turbines must operate under. The source test is really a snap-shot of emissions, and represents only specific conditions at the time of the test. However, if you were to pick the conditions of the source test, the source test data results would be reproduced.

Following the tables comparing the NOx and CO emission factors for the turbines, there are several exhibits that describe the origin of the emission factors used for the other criteria pollutants. This information is shown on several tables in Exhibit VI. Calculations are also shown for explaining how the various air contaminant emission factors were determined.

The summary of all of the information requested for each of the emission sources at CCP is given in Exhibit II, which is a series of tables, that identify each air contaminant, by

calendar year. There is also an explanation of what each column of the tables mean, and how the information in the table was determined. We have included an additional table at the end of Exhibit II which converts emissions from the Model R turbines to ppm.

Item 3 a. Discrepancies in current PSD permit and June 1989 application for allowable emissions for NO_X and CO.

Response: We have reviewed the permit history, and have corrected the emission estimates for permitted emissions at the CCP to reflect 646 tpy NO_X, and 120.00 tpy CO.

Item 3. b. Broach heaters reduced rating.

Response: The Broach heaters have a rated capacity of 37.5 MMBtu/hr. However, our data shows their operational rate to be 28.3 MMBtu/hr. This is the heat released value for the heaters. Heat released values and heat absorbed values were presented in Mr. Major's correspondence. Exhibit II shows the revised rates for these heaters.

Item 3.c. Calculations for heater emissions omitted.

Response: The calculations used for heater emissions are included as Exhibit VII of the attachments.

Item 3 d. Clarification of the emission rates and calculations presented for existing sources and the new PSD permit application.

Response: The historical information from previous permit applications was reviewed in the preparation of Exhibit II. The exhibit identifies emission estimates used previously (Analyzed Emissions, column N) and values were corrected.

We agree that NSPS does not apply to the original 12 turbines at the CCP, installed before 1977. As stated previously, the source test data was included in the empirical evaluation to establish emission factors applicable to these turbines. Actual fuel rates and ambient temperature was used, along with manufacturer data to derive the emission factors. However, our studies show that the source test is a snap-shot of operational conditions, and does not represent how a particular piece of equipment will perform throughout its range of conditions. We believe the emission factors we have developed do describe the ranges of capability of these emission sources.

Item 3 e. Fugitive emission estimates to be included in permit application.

Response: Our emissions calculations given in the permit application, and those included in Exhibit II of this response address particulate matter and VOC emissions. We believe that natural gas slip is accounted for in the turbine/heater VOC emissions data.

Item 3 f. Volatile hydrocarbon emission estimates for each source including the diesel fuel storage tank and the fire suppression system.

Response: We have included the volatile hydrocarbon emissions for emission sources listed in Exhibit II. The VOC losses from the diesel storage tank are estimated in the enclosed, Estimate of Emissions from Storage of Organic Liquids, Exhibit VIII. We did not address the very small (50.5 bbls) tank in our emissions estimate. Please note that the diesel storage tank stores fuel for the diesel generators. Since these sources are for emergency purposes, the fuel turnover in the tank is very small. The fire suppression system has no VOC emissions.

Item 3 g. Indicate which of the turbines are Model M turbines, and revise the emission rating for the Model M turbines.

Response: The two older design Model M turbines were converted to Model R machines shortly after installation, with a change of the second stage reaction turbine during overhaul. The conversion allowed parts to be interchanged among all CCP turbines, and allowed the converted machines to operate at the designated nominal 25,000 hp. It should be pointed out that the Model M was only marginally different from the Model R type of machine. There are only Model R type machines at the CCP currently. One machine, Unit 1806, has advanced technical parts (ATP) installed, although it also is a Model R machine (designated GE 5251 RATP in Exhibit II). As can be seen from the data in Exhibit II, the ATP machine performs consistently with the other turbines, and shows no increase in emissions.

Item 4 a. Provide a complete hard copy of the modeling runs entitled annual (and hourly) ambient NO_2 concentrations for the receptors selected.

Response: Two diskettes are enclosed containing ISC model output listings and data files. These files are more clearly described in the enclosed Exhibit, IX.

Item 4 b. Provide a modeling output report for annual NO_X impacts and listing of NO2 concentrations for all receptors for the simulations of only CCP sources before modification and only CCP sources after modification.

Response: The requested modeling output report is provided, enclosed as Exhibit X.

Item 4 c. Submit a re-evaluation of the modeling if changes in the source data warrant re-modeling.

Response: We have revised the emissions data presented in the GHX-1 air permit application to more accurately reflect the actual and allowable emissions for the turbines and heaters at the CCP. We have reviewed the existing and historical permits for the CCP as issued by ADEC and EPA Region X, and have constructed a "Permit History" for the CCP (which is attached). The permit history shows the "allowable" limits exist only for one of the existing 13 turbines at the CCP. This turbine has a limit of 646 tpy NO_X and 120 tpy CO. The other 12 turbines are "grandfathered" sources and have no limit in any ADEC or EPA permit.

In the absence of a specific permit limit on NOx for most of the CCP turbines, we have based our analysis of the existing configuration on what we call the "potential"

emissions. As explained under Exhibit II, the "potential" emissions are calculated based on the maximum hourly fuel consumption and continuous operation. As such, these values represent a maximum upper limit for these sources.

As a result of updated information from the vendor, new and modified source emissions were changed. We have performed additional modeling analyses incorporating these changes to emissions estimates to reflect the potential impacts to ambient air. We have revised and updated Tables 1-1, 2-1, 2-2, 2-3, 2-4, 2-5, 3-3, 3-4, 3-5, 3-6, 4-8, 4-9, Figures 4-9, 4-10, 4-11 and Appendix A from our application to reflect the the changes in source description, performance data, emissions from existing and proposed sources, and summaries of NO_2 and CO impacts as appropriate. These revised tables are enclosed, Exhibit XI.

Item 5 a. Evaluation of NOx reduction technology for natural gas industry prime movers. Prepared for the Gas Research Institute by Southwest Research Institute.

Response: A copy of the document is enclosed.

Item 5 b. Environmental impact report for proposed rule 1134. Control of oxides of nitrogen from stationary gas turbines. Prepared by South Coast Air Quality Management District.

Response: A copy of the document is enclosed.

Item 6. Provide a detailed economics analysis for the proposed equipment modifications and installations. Model the analyses on the presentations given in appendix B through D, including both maintenance and operation costs.

Response: We have prepared a thorough evaluation of the equipment and installation costs in the BACT section of our application. We have included line item identification of the operating and maintenance costs, as well. We believe that this is responsive to your request.

Experimental Turbine Compressor Upgrade at the CCP

In an earlier conversation with your staff, we discussed our plans to convert one of the turbines at the CCP from Model R to Model P. The upgrade will include: 1) in-place conversion of the GE Frame 5 gas turbine from a Model R to Model P; and 2) upgrade of gear and compressor internals consistent with the improved turbine performance. The following gives you a more clear explanation of the purposes for the test.

As you are aware, our PSD permit application covers the conversion of all 13 existing units at the CCP. However, because of the technical and logistical complexity of such an upgrade, we are interested in pursuing this single experimental upgrade prior to implementing the full conversion program.

This experimental upgrade will allow us to evaluate the critical parameters of the R to P conversions components of the GHX-1 Project as follows:

1. Determination of the actual cost and the degree of difficulty of converting this equipment within the operating facility. The impact of limited work space and lifting/rigging resources within the turbine compressor module can only be evaluated with a trial conversion.
2. Identify and quantify the degree to which the equipment conversion activity will impact the normal operation of the CCP.
3. Verify the performance improvement benefit of the planned upgrade, as well as the impact to the CCP process and utility systems. We plan to conduct an extensive testing program of the upgraded equipment and the associated CCP systems to better define the effect on plant operation.

The information gained from the experimental upgrade is crucial to cost and schedule planning for the full GHX-1 Project.

We understand that this trial conversion could only occur if there are already permitted emissions at the CCP that would address the increased emissions from the experimental conversion. Only one turbine has an emission limit, 646 tpy NO_X. Actual operation of the unit results in "actual" emissions of 379 tpy NO_X. Other machines show actual emissions very close to "analyzed" emissions, although there are no permit limits for these sources. If the permit limit for the one machine is used to determine the amount of time that the converted P Model is allowed to run, the following calculations apply.

	NO_X	CO
Permit limit	646 tpy	120
Existing Emissions	379 tpy	43
Emissions Available	267 tpy	77
Model P Expected	753 tpy	48
Existing Emissions	379 tpy	43
Emissions Increase	374 tpy	5

To determine the amount of time the P Model can operate at increased NO_X emission rates, a ratio between the difference of each NO_X amount is determined.

$\frac{267 \text{ tpy}}{374 \text{ tpy}} = 0.714$ Multiplying by the number of days in a year we get 261 days.

This means that the P model would be allowed to operate for 261 days in 1990, or until the new air permit, which authorizes increased emissions is issued. CO emissions would allow even more time to operate.

We believe that there is ample justification for allowing the experimental conversion of one Model R to Model P turbine at the CCP.

Following successful experimental conversion, the conversion of the remainder of the machines will begin in late 1990 or early 1991. We request that the single experimental conversion be allowed to go forward as planned in the first quarter, 1990. We want to thank your staff for continuing to work with us on this permit modification. We hope that we have answered the request for information from you. We look forward

to meeting with your staff within the next couple of weeks to discuss the details of this response.

Please contact me at (907) 265-1546 if you have any questions or if I can assist further in your review.

Sincerely,

T. H. Pinson

Timothy H. Pinson
GHX Permit Director

c.c
S. Hungerford, ADEC, Juneau
J. Coutts, ADEC, Fairbanks